

## **APPENDIX A: OPINION OF PROBABLE COST**

The following is a list of assumptions used to develop the opinion of probable construction costs:

Option 1 – Grand Junction Rail with Multi-purpose Trail

General - for all Segments:

- Quantities are based on conceptual study sketches and brief field visits and will need to be verified during the design stage
- Trail is 12 ft wide with 3 ft shoulders on each side
- Trail pavement structure includes 2" top course, 4" binder course, and 6" compacted gravel borrow subbase
- Gravel Borrow extends to the limits of the proposed shoulders
- Slope off shoulders are 4 (Horizontal) : 1 (Vertical)
- No excavated material will be reused
- Entire width of new trail section needs to be cleared and grubbed due to overgrowth
- Using unit price of \$68 for Grigliato Fence (Note: cost for black chain link fence is approximately \$35 per lf)
- Number of trees has been assumed
- Type and size of new trees has not been determined
- Number of new trees proposed equals number of trees assumed to be removed
- Electric lighting poles have a maximum height of 15 feet and are spaced 75 feet apart
- Electric handholes are spaced every 150 feet and electric manholes are spaced every 100 feet
- Four control box/load centers have been assumed to be located in Segment 1, 2, 4 and 6
- Emergency Call Box item includes a 12'x12'x6' NEMA Type 4 Box, Blue Warning Beacon, 25 ft conduit and 25 ft wiring
- Spacing of Emergency Call Boxes has been assumed at 500 feet - the actual locations will need to be determined during the design phase
- Land acquisitions are NOT included
- Design phase to start July 2006, completed project bid in July 2007, awarded to Contractor in October 2007, construction to begin April 2008
- Segments 2, 3, 4 & 6 estimated at a 6 month construction period; Segment 5 at 1 year; Segment 1 at 2 years
- Inflation rate is calculated at halfway point of estimate construction -- Segment 6 = 39 mo = 36 months to start + 3 mo to halfway point of construction

Segment 1:

- Trail is located to the west of the RR tracks
- Quarter of excavated material is old RR track to be removed

Segment 2:

- Trail is located to the west of the RR tracks

Segment 3:

- Trail will be located adjacent to sidewalk NOT next to the RR tracks
- Utility manholes located in the 2-3 foot "hole" will be removed and replaced with "deep" manholes
- Relocating playground equipment is not included. Only hedge and fence removal is included
- Trail crossing will be located at the Main Street/Vassar Street/G.G. Way intersection
- New fencing is NOT needed

Segment 4:

- Trail will be located adjacent to sidewalk NOT next to the RR tracks
- Trail elevation matches existing elevation for approximately 600 feet
- Trail then slopes downhill to meet elevation of tracks - change of elevation assumed to be 2 feet

Segment 5:

- Relocate fencing to allow enough room for trail in between the fence and the rail
- Trail is located to the west of the existing RR tracks
- Trail elevation matches existing elevation

Segment 6:

- Trail is located on the east side of the RR tracks
- Ground looks slightly sloped and have assumed excavation to be 10 inches deep
- Pedestrian Crossing Signal Equipment includes relocating the existing controller box, warning arms, all necessary wiring and pavement markings

#### Cambridge Street Crossing:

- Install new pedestrian (trail) signal for crossing over Cambridge Street
- Eliminate the existing pedestrian signal (to be combined with new trail crossing)
- Relocate both RR signal poles
- Relocate one ornamental street light
- RR signal relocations include relocating the existing posts, warning arms, signs, lights, all necessary wiring and pavement markings

#### Binney Street Crossing:

At this point, it is assumed that a signalized crossing is not needed at this location. However, given that changes will be made to the nearby intersection of Binney Street and Fulkerson Street in the form of a new signal, it may be that future analysis will recommend a signal here. This estimate reflects the cost as an option.

- RR signal poles are okay where they are
- New pedestrian signal to be installed for trail crossing Binney Street
- Interconnection of pedestrian signal and RR signal
- Interconnection of pedestrian signal and new signal at Binney/Fulkerson
- Relocate signal control box

#### Broadway Crossing:

- Trail will cross at existing crosswalk
- Relocate two signal control boxes
- Relocate red utility box
- Utility structure to be rebuilt/adjusted

#### Main Street Crossing:

- Relocate one RR signal pole
- Install warning signs

Massachusetts Avenue Crossing:

- Traffic counts and analysis has been completed by others
- Interconnect the two traffic signals with the trail crossing signal
- Interconnect the trail crossing signal with the RR crossing warning signal
- Location of RR signal poles are okay where they are
- The controller boxes at the two traffic signals will be replaced
- Install new trail crossing signal
- New conduit will be installed between all signals
- New sidewalk will be installed where conduit trenches disturbed existing sidewalks

Pedestrian Crossing over Tracks - Main Street to Massachusetts Avenue:

- Locations of RR signal warning poles do not need to be relocated

Pedestrian Crossing over Tracks - Massachusetts Avenue to Memorial Drive/Brookline Street Intersection:

- Locations of RR signal warning poles do not need to be relocated

Option 2 – Grand Junction Rail with Multi-purpose Trail and One-Way BRT

General - for all Segments:

- All assumptions made for Option 1 also apply to Option 2 unless noted below
- Bus route is one-way
- Cross section includes 3' shoulder + 12' trail + 2' barrier + 11' bus lane + fence + 17' rail lane
- Busway and railway are accommodated in 28' width and divided by fence
- Materials for construction of the bus route were not calculated (including barrier)
- Land related costs are not included

Segment 1 & 2:

- Existing rail to be relocated to the south to allow room for bus route
- See Track Relocation Breakdown for assumptions for track work (as completed by Edwards & Kelcey)

Segment 4:

- Relocate approximately 500 ft of RR tracks to the west

Segment 5:

- Relocate RR tracks to the west
- Trail is located to the east of the existing RR tracks

Segment 6:

- Rail to be relocated to the east side of the ROW so the trail can be built on the west side of the RR tracks

The following pages include the breakdown of the Opinion of Probable Construction and Design Costs for each of the segments in each of the Options. The breakdown shows a quantity and unit price for each item that would be used during construction by segments. The chart is subtotaled and detailed with the associated costs of construction. The construction cost is then totaled. The chart also includes an estimated cost for design and engineering oversight during construction with a grand total cost for the entire design and construction of the trail.

CITY OF CAMBRIDGE - Option 1  
Grand Junction Rail with Multi-Purpose Trail  
Opinion of Probable Construction Costs

			TRAIL QUANTITIES										UTILITY QUANTITIES																	
Segment No.	Street	Length of Trail	Clearing and Grubbing	Excavation	Remove and Dispose of Unused RR Track	Gravel Borrow Subbase	Hot Mix Asphalt Top Course	Hot Mix Asphalt Binder Course	Fence Remove and Reset	6 ft Fence	Fence Removed and Stacked	4 Inch Yellow Pavement Markings (Thermoplastic)	New Trail Crossing Ped Signal and coordiante with Exist	New Pedestrain Signal at Trail Crossing	Trail Crossing to be Included in Existing Traffic Signal	Relocate One Side of Exist Signal Equipment at Trail	New Signal Equipment for Trail Crossing Street and	Upgrade Ped Signals at Existing Traffic Signal	Hydrant Remove and Reset	Lighting Poles and Luminaires	Electirc Conduit for Lighting System	Electric Wiring for Lighting System	Electric Handholes for Lighting System	Precast Electric Manholes for Lighting System	Electric Control Boxes / Load Center for Lighting	Utility Manhole Removal	Utility Manhole - Deep	Utility Structures Adjusted with Concrete Slab	Emergency Call Box	
	Units	LF	A	CY	LF	CY	TON	TON	LF	LF	LF	LF	LS	LS	LS	LS	LS	LS	EA	LS	LF	LF	EA	EA	EA	EA	EA	EA	LS	EA
	Cost per Unit	LF	\$5,000	\$20	\$50	\$30	\$65	\$60	\$25	\$68	\$10	\$3	\$135,000	\$110,000	\$8,500	\$15,500	\$140,000	\$5,000	\$4,100	\$4,400	\$36	\$3	\$600	\$2,700	\$60,000	\$750	\$5,500	\$10,000	\$1,800	
1	Memorial Drive/Brookline Street Intersection to Massachusetts Avenue																													
1	Memorial Drive/Brookline St Int to Path Extention	750	0.4	420	0	340	115	225	0	0	0	750	0	0	0	0	0	1	1	10	830	830	5	5	0	0	0	0	1	
1	Path Extention to Massachusetts Avenue	3810	1.9	1940	1500	1560	560	1140	300	3810	0	3810	0	0	0	0	0	0	0	51	3500	3500	26	26	1	0	0	0	7	
	Sub-Total	4,560	2.3	2360	1500	1900	675	1365	300	3810	0	4560	0	0	0	0	0	1	1	61	4330	4330	31	31	1	0	0	0	8	
2	Massachusetts Avenue to Main Street	1425	0.1	700	0	860	220	430	1425	1425	0	1425	0	0	0	0	0	0	0	19	1570	1570	10	2	1	0	0	0	2	
2	Massachusetts Avenue Crossing		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
	Sub-Total	1,425	0.1	700	0	860	220	430	1425	1425	0	1425	0	0	0	0	1	0	0	19	1570	1570	10	2	1	0	0	0	2	
3	Main Street to Broadway	740	0.05	840	0	380	110	230	150	0	150	740	0	0	0	0	0	0	0	10	820	820	5	1	0	2	2	0	1	
3	Main Street Crossing		0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Sub-Total	740	0.05	840	0	380	110	230	150	0	150	740	0	0	0	1	0	0	0	10	820	820	5	1	0	2	2	0	1	
4	Broadway to Binney Street	730	0.05	430	0	400	110	220	150	0	0	730	0	0	0	0	0	0	0	10	800	800	5	1	1	0	0	1	1	
4	Broadway Crossing		0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Sub-Total	730	0.05	430	0	400	110	220	150	0	0	730	0	0	1	0	0	0	0	10	800	800	5	1	1	0	0	1	1	
5	Binney Street to Cambridge Street	1810	0.5	1350	0	760	270	550	1810	1810	0	1810	0	0	0	0	0	0	0	24	2000	2000	12	2	0	0	0	0	4	
5	Binney Street Crossing		0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Sub-Total	1,810	0.5	1350	0	760	270	550	1810	1810	0	1810	0	1	0	0	0	0	0	24	2000	2000	12	2	0	0	0	0	4	
6	Cambridge Street to Gore Street	510	0.25	300	0	220	80	160	250	510	0	510	0	0	0	0	0	0	0	7	560	560	4	1	1	0	0	0	1	
6	Cambridge Street Crossing		0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Sub-Total	510	0.25	300	0	220	80	160	250	510	0	510	1	0	0	0	0	0	0	7	560	560	4	1	1	0	0	0	1	
	GRAND TOTAL	9,775 LF	3.25 A	5980 CY	1500 LF	4520 CY	1465 TON	2955 TON	4085 LF	7555 LF	150 LF	9775 LF	1 LS	1 LS	1 LS	1 LS	1 LS	1 LS	1 EA	131 LS	10080 LF	10080 LF	67 EA	38 EA	4 EA	2 EA	2 EA	1 LS	17 EA	

CITY OF CAMBRIDGE - Option 1  
Grand Junction Rail with Multi-Purpose Trail  
Opinion of Probable Construction Costs

		LANDSCAPING QUANTITIES						SUB-TOTALS												
Segment No.	Street	Loam Borrow	Seeding	Tree Protection	Tree Removal	Hedge/Shrub Removal	Tree	Trail Quantities (A)	Utility Quantities (B)	Landscaping Quantities (C)	Trail, Utility, and Landscaping Sub-total (A+B+C) = (D)	Soil and Watse Management (E) = Subtotal (D) * 10.5%	Base Construction Sub-Total (D+E) = (F)	Mobilization (G) = Subtotal (F) * 5%	Base Construction Sub-Total (F+G) = (H)	Fixed Factor (I)	Construction Contingency (H*I) = (J)	Base Construction Total with Contingency (H+J) = (K)	Fixed Factor (L)	
	Units	CY	SY	EA	EA	LF	EA	\$	\$	\$	\$	\$	\$	\$	\$	%	\$	\$	%	
	Cost per Unit	\$35	\$1	\$100	\$400	\$100	\$800													
1	Memorial Drive/Brookline Street Intersection to Massachusetts Avenue																			
1	Memorial Drive/Brookline St Int to Path Extention	130	950	4	0	0	0	\$ 43,825	\$ 103,355	\$ 5,900	\$ 153,080	\$ 16,073	\$ 169,153	\$ 8,458	\$ 177,611	40%	\$ 71,044	\$ 248,655	5%	
1	Path Extention to Massachusetts Avenue	560	4240	4	0	0	0	\$ 552,910	\$ 517,550	\$ 24,240	\$ 1,094,700	\$ 114,944	\$ 1,209,644	\$ 60,482	\$ 1,270,126	40%	\$ 508,050	\$ 1,778,176	5%	
	Sub-Total	690	5190	8	0	0	0	\$ 596,735	\$ 620,905	\$ 30,140	\$ 1,247,780	\$ 131,017	\$ 1,378,797	\$ 68,940	\$ 1,447,737		\$ 579,095	\$ 2,026,831		
2	Massachusetts Avenue to Main Street	310	2220	0	0	0	0	\$ 217,200	\$ 219,045	\$ 13,070	\$ 449,315	\$ 47,178	\$ 496,493	\$ 24,825	\$ 521,318	40%	\$ 208,527	\$ 729,845	5%	
2	Massachusetts Avenue Crossing	0	0	0	0	0	0	\$ -	\$ 140,000	\$ -	\$ 140,000	\$ 14,700	\$ 154,700	\$ 7,735	\$ 162,435	40%	\$ 64,974	\$ 227,409	5%	
	Sub-Total	310	2220	0	0	0	0	\$ 217,200	\$ 359,045	\$ 13,070	\$ 589,315	\$ 61,878	\$ 651,193	\$ 32,560	\$ 683,753		\$ 273,501	\$ 957,254		
3	Main Street to Broadway	160	1160	12	45	150	50	\$ 56,870	\$ 95,570	\$ 80,960	\$ 233,400	\$ 24,507	\$ 257,907	\$ 12,895	\$ 270,802	40%	\$ 108,321	\$ 379,123	5%	
3	Main Street Crossing	0	0	0	0	0	0	\$ -	\$ 15,500	\$ -	\$ 15,500	\$ 1,628	\$ 17,128	\$ 856	\$ 17,984	40%	\$ 7,194	\$ 25,177	5%	
	Sub-Total	160	1160	12	45	150	50	\$ 56,870	\$ 111,070	\$ 80,960	\$ 248,900	\$ 26,135	\$ 275,035	\$ 13,752	\$ 288,786		\$ 115,514	\$ 404,301		
4	Broadway to Binney Street	80	540	4	1	0	1	\$ 47,140	\$ 152,300	\$ 4,940	\$ 204,380	\$ 21,460	\$ 225,840	\$ 11,292	\$ 237,132	40%	\$ 94,853	\$ 331,985	5%	
4	Broadway Crossing	0	0	0	0	0	0	\$ -	\$ 8,500	\$ -	\$ 8,500	\$ 893	\$ 9,393	\$ 470	\$ 9,862	40%	\$ 3,945	\$ 13,807	5%	
	Sub-Total	80	540	4	1	0	1	\$ 47,140	\$ 160,800	\$ 4,940	\$ 212,880	\$ 22,352	\$ 235,232	\$ 11,762	\$ 246,994		\$ 98,798	\$ 345,792		
5	Binney Street to Cambridge Street	230	1610	12	8	0	8	\$ 276,610	\$ 202,400	\$ 20,460	\$ 499,470	\$ 52,444	\$ 551,914	\$ 27,596	\$ 579,510	40%	\$ 231,804	\$ 811,314	5%	
5	Binney Street Crossing	0	0	0	0	0	0	\$ -	\$ 110,000	\$ -	\$ 110,000	\$ 11,550	\$ 121,550	\$ 6,078	\$ 127,628	40%	\$ 51,051	\$ 178,679	5%	
	Sub-Total	230	1610	12	8	0	8	\$ 276,610	\$ 312,400	\$ 20,460	\$ 609,470	\$ 63,994	\$ 673,464	\$ 33,673	\$ 707,138		\$ 282,855	\$ 989,993		
6	Cambridge Street to Gore Street	65	460	4	0	0	0	\$ 71,110	\$ 119,260	\$ 3,135	\$ 193,505	\$ 20,318	\$ 213,823	\$ 10,691	\$ 224,514	40%	\$ 89,806	\$ 314,320	5%	
6	Cambridge Street Crossing	0	0	0	0	0	0	\$ -	\$ 135,000	\$ -	\$ 135,000	\$ 14,175	\$ 149,175	\$ 7,459	\$ 156,634	40%	\$ 62,654	\$ 314,320	5%	
	Sub-Total	65	460	4	0	0	0	\$ 71,110	\$ 254,260	\$ 3,135	\$ 328,505	\$ 34,493	\$ 362,998	\$ 18,150	\$ 381,148		\$ 152,459	\$ 628,640		
	GRAND TOTAL	1535 CY	11180 SY	40 EA	54 EA	150 LF	59 EA	\$ 1,265,665	\$ 1,818,480	\$ 152,705	\$ 3,236,850	\$ 339,869	\$ 3,576,719	\$ 178,836	\$ 3,755,555		\$ 1,502,222	\$ 5,352,810		



CITY OF CAMBRIDGE - Option 1 Grand Junction Rail with Multi-Purpose Trail Opinion of Probable Construction Costs								
Segment No.		Police Detail (K*L) = (M)	Base Construction Total with Contingency (K+M) = (N)	Inflation Rate 0.283% per month (fixed)	Construction TOTAL (I+K+M) = (N)	Design Fee (Assumed 10% of Total Construction Cost)	Construction Oversight Fee (Assumed 10% of Total Construction Cost)	Design, Construction, and Construction Oversight TOTAL
	Street							
	Units							
	Cost per Unit	\$	\$		\$	\$	\$	\$
1	Memorial Drive/Brookline Street Intersection to Massachusetts Avenue							
1	Memorial Drive/Brookline St Int to Path Extention	\$ 3,552	\$ 252,208	\$ 59,955	\$ 312,163	\$ 31,216	\$ 31,216	\$ 374,595
1	Path Extention to Massachusetts Avenue	\$ 25,403	\$ 1,803,578	\$ 428,747	\$ 2,232,325	\$ 223,233	\$ 223,233	\$ 2,678,790
	Sub-Total	\$ 28,955	\$ 2,055,786	\$ 488,701	\$ 2,544,488	\$ 254,449	\$ 254,449	\$ 3,053,385
2	Massachusetts Avenue to Main Street	\$ 36,492	\$ 766,337	\$ 149,643	\$ 915,980	\$ 91,598	\$ 91,598	\$ 1,099,176
2	Massachusetts Avenue Crossing	\$ 11,370	\$ 238,779	\$ 46,626	\$ 285,406	\$ 28,541	\$ 28,541	\$ 342,487
	Sub-Total	\$ 47,863	\$ 1,005,117	\$ 196,269	\$ 1,201,386	\$ 120,139	\$ 120,139	\$ 1,441,663
3	Main Street to Broadway	\$ 18,956	\$ 398,079	\$ 70,974	\$ 469,053	\$ 46,905	\$ 46,905	\$ 562,864
3	Main Street Crossing	\$ 1,259	\$ 26,436	\$ 4,713	\$ 31,150	\$ 3,115	\$ 3,115	\$ 37,380
	Sub-Total	\$ 20,215	\$ 424,516	\$ 75,687	\$ 500,203	\$ 50,020	\$ 50,020	\$ 600,243
4	Broadway to Binney Street	\$ 16,599	\$ 348,584	\$ 56,230	\$ 404,814	\$ 40,481	\$ 40,481	\$ 485,777
4	Broadway Crossing	\$ 690	\$ 14,497	\$ 2,339	\$ 16,836	\$ 1,684	\$ 1,684	\$ 20,203
	Sub-Total	\$ 17,290	\$ 363,081	\$ 58,569	\$ 421,650	\$ 42,165	\$ 42,165	\$ 505,980
5	Binney Street to Cambridge Street	\$ 40,566	\$ 851,880	\$ 115,719	\$ 967,599	\$ 96,760	\$ 96,760	\$ 1,161,119
5	Binney Street Crossing	\$ 8,934	\$ 187,612	\$ 25,485	\$ 213,098	\$ 21,310	\$ 21,310	\$ 255,717
	Sub-Total	\$ 49,500	\$ 1,039,492	\$ 141,205	\$ 1,180,697	\$ 118,070	\$ 118,070	\$ 1,416,836
6	Cambridge Street to Gore Street	\$ 4,490	\$ 318,810	\$ 35,187	\$ 353,997	\$ 35,400	\$ 35,400	\$ 424,797
6	Cambridge Street Crossing	\$ 3,133	\$ 317,453	\$ 35,037	\$ 352,490	\$ 35,249	\$ 35,249	\$ 422,988
	Sub-Total	\$ 7,623	\$ 636,263	\$ 70,224	\$ 706,487	\$ 70,649	\$ 70,649	\$ 847,784
	GRAND TOTAL	\$ 171,445	\$ 5,524,255	\$ 1,030,655	\$ 6,554,910	\$ 655,491	\$ 655,491	\$ 7,865,892

**CITY OF CAMBRIDGE - Option 1 - Grand Junction Rail w/ Multi-Purpose Trail**  
**Opinion of Probable Construction Costs**  
**Signal System Modification Breakdown**

Trail Crossing	Item Descriptions	Unit	Quantity	Unit Cost	TOTAL
<b>Memorial Drive at Reid Overpass and Cottage Farm Bridge</b>					
	Upgrade ped signals at existing signal	LS	1	\$5,000	\$5,000
					<b>\$5,000</b>
<b>Massachusetts Avenue Crossing</b>					
	The controller boxes at the two traffic signals will be replaced	EA	2	\$10,000	\$20,000
	Install new trail crossing signal	LS	1	\$100,000	\$100,000
	New interconnect conduit will be installed between all signals	LS	1	\$5,000	\$5,000
	New sidewalk will be installed where conduit trenches disturbed existing sidewalks	LS	1	\$15,000	\$15,000
					<b>\$140,000</b>
<b>Main Street Crossing</b>					
	Relocate one RR signal pole	LS	1	\$15,000	\$15,000
	Install warning signs	LS	1	\$500	\$500
					<b>\$15,500</b>
<b>Broadway Crossing</b>					
	Relocate two signal control boxes	LS	1	\$5,000	\$5,000
	Relocate red utility box	LS	1	\$1,500	\$1,500
	Utility structure to be rebuilt/adjusted	LS	1	\$2,000	\$2,000
					<b>\$8,500</b>
<b>Binney Street Crossing (Included as an option only)</b>					
	New ped signal to be installed for trail crossing Binney Street	LS	1	\$100,000	\$100,000
	Interconnection to future signal at Fulkerson/Binney Streets	LS	1	\$5,000	\$5,000
	Interconnection of ped signal and RR signal	LS	1	\$5,000	\$5,000
	Relocate signal control box	LS	1	\$5,000	\$5,000
					<b>\$115,000</b>
<b>Cambridge Street Crossing</b>					
	Install new ped (trail) signal for crossing over Cambridge Street	LS	1	\$100,000	\$100,000
	Eliminate the existing ped signal (to be combined with new trail crossing)	LS	1	\$3,000	\$2,000
	Relocate both RR signal poles	EA	2	\$15,000	\$30,000
	Relocate one ornamental street light	EA	1	\$2,500	\$3,000
					<b>\$135,000</b>

CITY OF CAMBRIDGE - Option 2																														
Grand Junction Rail with Multi Purpose Trail and One-Way Urban Ring Bus Rapid Transit																														
Opinion of Probable Construction Costs																														
			TRAIL QUANTITIES											UTILITY QUANTITIES																
Segment No.	Street	Length of Trail	Clearing and Grubbing	Excavation	Remove and Dispose of Unused RR Track	Gravel Borrow Subbase	Hot Mix Asphalt Top Course	Hot Mix Asphalt Binder Course	Fence Remove and Reset	6 ft Fence	Fence Removed and Stacked	4 Inch Yellow Pavement Markings (Thermoplastic)	Relocate Main Rail Line and Siding	New Trail Crossing Ped Signal and coordiante with Exist	New Pedestrain Signal at Trail Crossing	Trail Crossing to be Included in Exisitng Traffic Signal	Relocate One Side of Exist Signal Equipment at Trail	New Signal Equipment for Trail Crossing Street and	Upgrade Ped Signals at Existing Traffic Signal	Hydrant Remove and Reset	Lighting Poles and Luminares	Electric Conduit for Lighting System	Electric Wiring for Lighting System	Electric Handholes for Lighting System	Precast Electric Manholes for Lighting System	Electric Control Boxes / Load Center for Lighting	Utility Manhole Removal	Utility Manhole - Deep	Utility Structures Adjusted with Concrete Slab	Emergency Call Box
	Units	LF	A \$5,000	CY \$20	LF \$50	CY \$30	TON \$65	TON \$60	LF \$25	LF \$52	LF \$10	LF \$3	LF \$400	LS \$135,000	LS \$110,000	LS \$8,500	LS \$15,500	LS \$140,000	LS \$5,000	EA \$4,100	LS \$4,400	LF \$36	LF \$3	EA \$600	EA \$2,700	EA \$60,000	EA \$750	EA \$5,500	LS \$10,000	EA \$1,800
1	Memorial Drive/Brookline Street Intersection to Massachusetts Avenue																													
1	Memorial Drive/Brookline St Int to Path Extention	750	0.4	420	0	340	115	225	0	0	0	750	0	0	0	0	0	0	1	1	10	830	830	5	5	0	0	0	0	1
1	Path Extention to Massachusetts Avenue	3810	1.9	1940	1500	1560	560	1140	300	3810	0	3810	3800	0	0	0	0	0	0	0	51	3500	3500	26	26	1	0	0	0	7
	Sub-Total	4,560	2.3	2360	1500	1900	675	1365	300	3810	0	4560	3800	0	0	0	0	0	1	1	61	4330	4330	31	31	1	0	0	0	8
2	Massachusetts Avenue to Main Street	1425	0.1	700	0	860	220	430	1425	1425	0	1425	1400	0	0	0	0	0	0	0	19	1570	1570	10	2	1	0	0	0	2
2	Massachusetts Avenue Crossing		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Sub-Total	1,425	0.1	700	0	860	220	430	1425	1425	0	1425	1400	0	0	0	0	1	0	0	19	1570	1570	10	2	1	0	0	0	2
3	Main Street to Broadway	740	0.05	840	0	380	110	230	150	0	150	740	0	0	0	0	0	0	0	0	10	820	820	5	1	0	2	2	0	1
3	Main Street Crossing		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sub-Total	740	0.05	840	0	380	110	230	150	0	150	740	0	0	0	0	1	0	0	0	10	820	820	5	1	0	2	2	0	1
4	Broadway to Binney Street	730	0.05	430	0	400	110	220	150	0	0	730	500	0	0	0	0	0	0	0	10	800	800	5	1	1	0	0	1	1
4	Broadway Crossing		0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sub-Total	730	0.05	430	0	400	110	220	150	0	0	730	500	0	0	1	0	0	0	0	10	800	800	5	1	1	0	0	1	1
5	Binney Street to Cambridge Street	1810	0.5	1350	0	760	270	550	1810	1810	0	1810	1810	0	0	0	0	0	0	0	24	2000	2000	12	2	0	0	0	0	4
5	Binney Street Crossing		0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sub-Total	1,810	0.5	1350	0	760	270	550	1810	1810	0	1810	1810	0	1	0	0	0	0	0	24	2000	2000	12	2	0	0	0	0	4
6	Cambridge Street to Gore Street	510	0.25	300	0	220	80	160	250	510	0	510	510	0	0	0	0	0	0	0	7	560	560	4	1	1	0	0	0	1
6	Cambridge Street Crossing		0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sub-Total	510	0.25	300	0	220	80	160	250	510	0	510	510	1	0	0	0	0	0	0	7	560	560	4	1	1	0	0	0	1
	GRAND TOTAL	9,775 LF	3.25 A	5980 CY	1500 LF	4520 CY	1465 TON	2955 TON	4085 LF	7555 LF	150 LF	9775 LF	8020 LF	1 LS	1 LS	1 LS	1 LS	1 LS	1 LS	1 EA	131 LS	10080 LF	10080 LF	67 EA	38 EA	4 EA	2 EA	2 EA	1 LS	17 EA

CITY OF CAMBRIDGE - Option 2																					
Grand Junction Rail with Multi Purpose Trail and One-Way Urban Ring Bus Rapid Transit																					
Opinion of Probable Construction Costs																					
		LANDSCAPING QUANTITIES						SUB-TOTALS													
Segment No.	Street	Loam Borrow	Seeding	Tree Protection	Tree Removal	Hedge/Shrub Removal	Tree	Trail Quantities (A)	Utility Quantities (B)	Landscaping Quantities (C)	Trail, Utility, and Landscaping Sub-total (A+B+C) = (D)	Soil and Watse Management (E) = Subtotal (D) * 10.5%	Base Construction Sub-Total (D+E) = (F)	Mobilization (G) = Subtotal (F) * 5%	Base Construction Sub-Total (F+G) = (H)	Fixed Factor (I)	Construction Contingency (H*I) = (J)	Base Construction Total with Contingency (H+J) = (K)	Fixed Factor (L)	Police Detail (K*L) = (M)	
	Units	CY	SY	EA	EA	LF	EA	\$	\$	\$	\$	\$	\$	\$	\$	%	\$	\$	%	\$	
	Cost per Unit	\$35	\$1	\$100	\$400	\$100	\$800														
1	Memorial Drive/Brookline Street Intersection to Massachusetts Avenue																				
1	Memorial Drive/Brookline St Int to Path Extention	130	950	4	0	0	0	\$ 43,825	\$ 103,355	\$ 5,900	\$ 153,080	\$ 16,073	\$ 169,153	\$ 8,458	\$ 177,611	40%	\$ 71,044	\$ 248,655	5%	\$ 3,552	
1	Path Extention to Massachusetts Avenue	560	4240	4	0	0	0	\$ 2,011,950	\$ 517,550	\$ 24,240	\$ 2,553,740	\$ 268,143	\$ 2,821,883	\$ 141,094	\$ 2,962,977	40%	\$ 1,185,191	\$ 4,148,168	5%	\$ 59,260	
	Sub-Total	690	5190	8	0	0	0	\$ 2,055,775	\$ 620,905	\$ 30,140	\$ 2,706,820	\$ 284,216	\$ 2,991,036	\$ 149,552	\$ 3,140,588		\$ 1,256,235	\$ 4,396,823		\$ 62,812	
2	Massachusetts Avenue to Main Street	310	2220	0	0	0	0	\$ 754,400	\$ 219,045	\$ 13,070	\$ 986,515	\$ 103,584	\$ 1,090,099	\$ 54,505	\$ 1,144,604	40%	\$ 457,842	\$ 1,602,446	5%	\$ 80,122	
2	Massachusetts Avenue Crossing	0	0	0	0	0	0	\$ -	\$ 140,000	\$ -	\$ 140,000	\$ 14,700	\$ 154,700	\$ 7,735	\$ 162,435	40%	\$ 64,974	\$ 227,409	5%	\$ 11,370	
	Sub-Total	310	2220	0	0	0	0	\$ 754,400	\$ 359,045	\$ 13,070	\$ 1,126,515	\$ 118,284	\$ 1,244,799	\$ 62,240	\$ 1,307,039		\$ 522,816	\$ 1,829,855		\$ 91,493	
3	Main Street to Broadway	160	1160	12	45	150	50	\$ 56,870	\$ 95,570	\$ 80,960	\$ 233,400	\$ 24,507	\$ 257,907	\$ 12,895	\$ 270,802	40%	\$ 108,321	\$ 379,123	5%	\$ 18,956	
3	Main Street Crossing	0	0	0	0	0	0	\$ -	\$ 15,500	\$ -	\$ 15,500	\$ 1,628	\$ 17,128	\$ 856	\$ 17,984	40%	\$ 7,194	\$ 25,177	5%	\$ 1,259	
	Sub-Total	160	1160	12	45	150	50	\$ 56,870	\$ 111,070	\$ 80,960	\$ 248,900	\$ 26,135	\$ 275,035	\$ 13,752	\$ 288,786		\$ 115,514	\$ 404,301		\$ 20,215	
4	Broadway to Binney Street	80	540	4	1	0	1	\$ 247,140	\$ 152,300	\$ 4,940	\$ 404,380	\$ 42,460	\$ 446,840	\$ 22,342	\$ 469,182	40%	\$ 187,673	\$ 656,855	5%	\$ 32,843	
4	Broadway Crossing	0	0	0	0	0	0	\$ -	\$ 8,500	\$ -	\$ 8,500	\$ 893	\$ 9,393	\$ 470	\$ 9,862	40%	\$ 3,945	\$ 13,807	5%	\$ 690	
	Sub-Total	80	540	4	1	0	1	\$ 247,140	\$ 160,800	\$ 4,940	\$ 412,880	\$ 43,352	\$ 456,232	\$ 22,812	\$ 479,044		\$ 191,618	\$ 670,662		\$ 33,533	
5	Binney Street to Cambridge Street	230	1610	12	8	0	8	\$ 971,650	\$ 202,400	\$ 20,460	\$ 1,194,510	\$ 125,424	\$ 1,319,934	\$ 65,997	\$ 1,385,930	40%	\$ 554,372	\$ 1,940,302	5%	\$ 97,015	
5	Binney Street Crossing	0	0	0	0	0	0	\$ -	\$ 110,000	\$ -	\$ 110,000	\$ 11,550	\$ 121,550	\$ 6,078	\$ 127,628	40%	\$ 51,051	\$ 178,679	5%	\$ 8,934	
	Sub-Total	230	1610	12	8	0	8	\$ 971,650	\$ 312,400	\$ 20,460	\$ 1,304,510	\$ 136,974	\$ 1,441,484	\$ 72,074	\$ 1,513,558		\$ 605,423	\$ 2,118,981		\$ 105,949	
6	Cambridge Street to Gore Street	65	460	4	0	0	0	\$ 266,950	\$ 119,260	\$ 3,135	\$ 389,345	\$ 40,881	\$ 430,226	\$ 21,511	\$ 451,738	40%	\$ 180,695	\$ 632,433	5%	\$ 9,035	
6	Cambridge Street Crossing	0	0	0	0	0	0	\$ -	\$ 135,000	\$ -	\$ 135,000	\$ 14,175	\$ 149,175	\$ 7,459	\$ 156,634	40%	\$ 62,654	\$ 632,433	5%	\$ 3,133	
	Sub-Total	65	460	4	0	0	0	\$ 266,950	\$ 254,260	\$ 3,135	\$ 524,345	\$ 55,056	\$ 579,401	\$ 28,970	\$ 608,371		\$ 243,349	\$ 1,264,865		\$ 12,167	
	GRAND TOTAL	1535 CY	11180 SY	40 EA	54 EA	150 LF	59 EA	\$ 4,352,785	\$ 1,818,480	\$ 152,705	\$ 6,323,970	\$ 664,017	\$ 6,987,987	\$ 349,399	\$ 7,337,386		\$ 2,934,954	\$ 10,685,486		\$ 326,169	

CITY OF CAMBRIDGE - Option 2							
Grand Junction Rail with Multi Purpose Trail and One-Way Urban Ring Bus Rapid Transit							
Opinion of Probable Construction Costs							
Segment No.		Base Construction Total with Contingency (K+M) = (N)	Inflation Rate 0.283% per month (fixed)	Construction Total (I+K+M) = (N)	Design Fee (Assumed 10% of Total Construction Cost)	Construction Oversight Fee (Assumed 10% of Total Construction Cost)	Design, Construction, and Construction Oversight TOTAL
	Street						
	Units						
	Cost per Unit	\$		\$	\$	\$	\$
	Memorial Drive/Brookline Street Intersection to Massachusetts Avenue						
1	Memorial Drive/Brookline St Int to Path Extention	\$ 252,208	\$ 59,955	\$ 312,163	\$ 31,216	\$ 31,216	\$ 374,595
1	Path Extention to Massachusetts Avenue	\$ 4,207,427	\$ 1,000,190	\$ 5,207,617	\$ 520,762	\$ 520,762	\$ 6,249,140
	Sub-Total	\$ 4,459,635	\$ 1,060,144	\$ 5,519,779	\$ 551,978	\$ 551,978	\$ 6,623,735
	Massachusetts Avenue to Main Street						
2	Massachusetts Avenue Crossing	\$ 1,682,568	\$ 328,555	\$ 2,011,123	\$ 201,112	\$ 201,112	\$ 2,413,348
2		\$ 238,779	\$ 46,626	\$ 285,406	\$ 28,541	\$ 28,541	\$ 342,487
	Sub-Total	\$ 1,921,347	\$ 375,182	\$ 2,296,529	\$ 229,653	\$ 229,653	\$ 2,755,835
	Main Street to Broadway						
3	Main Street Crossing	\$ 398,079	\$ 70,974	\$ 469,053	\$ 46,905	\$ 46,905	\$ 562,864
3		\$ 26,436	\$ 4,713	\$ 31,150	\$ 3,115	\$ 3,115	\$ 37,380
	Sub-Total	\$ 424,516	\$ 75,687	\$ 500,203	\$ 50,020	\$ 50,020	\$ 600,243
	Broadway to Binney Street						
4	Broadway Crossing	\$ 689,697	\$ 111,255	\$ 800,952	\$ 80,095	\$ 80,095	\$ 961,143
4		\$ 14,497	\$ 2,339	\$ 16,836	\$ 1,684	\$ 1,684	\$ 20,203
	Sub-Total	\$ 704,195	\$ 113,594	\$ 817,788	\$ 81,779	\$ 81,779	\$ 981,346
	Binney Street to Cambridge Street						
5	Binney Street Crossing	\$ 2,037,317	\$ 276,749	\$ 2,314,067	\$ 231,407	\$ 231,407	\$ 2,776,880
5		\$ 187,612	\$ 25,485	\$ 213,098	\$ 21,310	\$ 21,310	\$ 255,717
	Sub-Total	\$ 2,224,930	\$ 302,234	\$ 2,527,164	\$ 252,716	\$ 252,716	\$ 3,032,597
	Cambridge Street to Gore Street						
6	Cambridge Street Crossing	\$ 641,467	\$ 70,799	\$ 712,266	\$ 71,227	\$ 71,227	\$ 854,719
6		\$ 635,565	\$ 70,147	\$ 705,713	\$ 70,571	\$ 70,571	\$ 846,855
	Sub-Total	\$ 1,277,033	\$ 140,946	\$ 1,417,979	\$ 141,798	\$ 141,798	\$ 1,701,574
	GRAND TOTAL	\$ 11,011,655	\$ 2,067,787	\$ 13,079,442	\$ 1,307,944	\$ 1,307,944	\$ 15,695,330

**CITY OF CAMBRIDGE - Option 2 - Grand Junction Rail with Multi Purpose Trail and One-Way Urban Ring Bus Rapid Transit**

**Opinion of Probable Construction Costs**

**Track and Railroad Signal Breakdown**

Track Relocation Estimate Completed by Edwards & Kelcey

Work ID No.	Item Descriptions	Unit	Quantity	Unit Cost	TOTAL
<b>Segment 1A - Begins at the siding turnout just east of Memorial Drive and continues to the southwest corner of the triangular lot just east of the pedestrian crossing</b>					
1	Remove and Relocate Track - Mainline	LF	1,900	\$110	\$209,000
1	Remove and Relocate Track - Siding	LF	1,900	\$110	\$209,000
2	Relocate Existing Pedestrian Grade Crossing Signal Equipment (Gates)	LS	1	\$50,000	\$50,000
3	Remove Necco Sidetrack	LF	1,500	\$40	\$60,000
3	Remove Turnout for Necco Sidetrack	LS	1	\$25,000	\$25,000
4	Remove and Relocate Pedestrian Grade Crossing	LF	10	\$300	\$3,000
5	Construction Staging at Siding Turnouts	LF	300	\$150	\$45,000
6	Railroad Testing/Acceptance	LS	1	\$3,200	\$3,200
7	Flagging Protection	LS	1	\$48,000	\$48,000
					<b>\$652,200</b>
<b>Segment 1B - Begins from the pedestrian crossing and continues to the west edge of the Massachusetts Avenue grade crossing</b>					
1	Remove and Relocate Track - Mainline	LF	2,750	\$110	\$302,500
1	Remove and Relocate Track - Siding	LF	2,750	\$110	\$302,500
5	Construction Staging at Siding Turnouts	LF	300	\$150	\$45,000
6	Railroad Testing/Acceptance	LS	1	\$1,600	\$1,600
7	Flagging Protection	LS	1	\$67,200	\$67,200
					<b>\$718,800</b>
<b>Segment 2 - Begins from the Massachusetts Avenue grade crossing and continues to the west edge of the Main Street grade crossing</b>					
3	Remove Mainline Track	LF	1500	\$40	\$60,000
1a	Build New Mainline Track	LF	1500	\$200	\$300,000
2	Relocate Existing Pedestrian Grade Crossing Signal Equipment (Gates)	LS	1	\$50,000	\$50,000
2	Relocate Existing Mass Ave. Grade Crossing Signal Equipment (Flashers)	LS	1	\$175,000	\$175,000
4	Remove and Relocate Mass. Ave. Grade Crossing	LF	100	\$300	\$30,000
4	Remove and Relocate Pedestrian Grade Crossing	LF	10	\$300	\$3,000
6	Railroad Testing/Acceptance	LS	1	\$6,400	\$6,400
7	Flagging Protection	LS	1	\$19,200	\$19,200
					<b>\$643,600</b>
				<b>Total =</b>	<b>\$2,014,600</b>
Average Price per LF (assuming 5,200 LF of track is relocated) =					\$387
				<b>SAY</b>	<b>\$400</b>
					<b>per LF</b>
<b>Work ID No. - Task Description and Assumptions</b>					
1	Cost includes equipment and labor necessary to remove and relocate existing track, clearing and grubbing, build new trackbed for relocated track, and disposal of hazardous and non-hazardous materials.				
1a	Cost includes the equipment and labor necessary to install subballast, ballast, ties, and rails to complete a new track.				
2	Cost includes the equipment and labor necessary to relocate existing at-grade crossing signal equipment (i.e., cable, conduit, mast arms, controller box, crossing surface material, etc)				
3	Cost includes the equipment and labor necessary to remove and salvage existing rails, ties, switching mechanisms, and ballast and transport salvaged materials to owner. Material that is not salvaged will be removed and disposed.				
4	Cost includes the equipment and labor necessary to remove and relocate existing grade crossing, build new trackbed for relocated crossing, purchase and install new crossing surface, and disposal of hazardous and non-hazardous materials.				
5	Cost includes the equipment and labor necessary for staged construction at existing turnouts to allow existing train movements to continue.				
6	Cost includes the loaded rate for track and signal inspection and acceptance by the railroad.				
7	Cost includes the loaded rate for flagging protection during track construction operations.				